# EXPERIMENTAL OF EARLY AGE CONCRETE USING PAITON FLY-ASH

To fulfill part requirements
reached a degree of Bachelor of S-1 Civil Engineering

Submitted by:

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# EXPERIMENTAL OF EARLY AGE CONCRETE USING PAITON FLY-ASH


## Abstrak

Berdasarkan hasil penelitian dan pembahasan yang telah diuraikan, maka dapat disimpulkan menjadi beberapa yang antara lain sebagai berikut: Umur perawatan beton sangat berpengaruh pada kekuatannya. Pada umur 1 hari Nilai kuat tekan yang didapatkan pada kadar *fly ash* 7 % yaitu 17,410 MPa, hasil yang diperoleh pada kadar *fly ash* 7 % lebih kuat nilai kuat tekannya dibandingkan dengan beton normal (tanpa menggunakan *fly ash*) yaitu 15,287 MPa.Pada kadar fly ash 9% diperoleh peningkatan sebesar 21,798 MPa dan kadar fly ash 11% diperoleh sebesar 17,155 Mpa, Sedangkan pada kadar fly ash 15 % mengalami penurunan kembali yaitu sebesar 15,853 MPa , dengan demikian nilai kuat tekan dengan menggunakan fly ash paiton optimalnya pada kadar 7% - 13%, karena kuat tekannya lebih tinggi dibandingkan beton normal atau tanpa menggunakan fly ash. Pada umur 28 hari nilai kuat tekan yang didapatkan pada beton normal (tanpa menggunakan *fly ash*) Mengalami peningkatan,kuat tekan beton normal diperoleh hingga melampaui kuat tekan rencana yaitu sebesar 30,007 MPa. Pada kadar fly ash 7% didapatkan nilai lebih tinggi dibandingkan beton normal yaitu sebesar 32,272 MPa, sedangkan pada kadar fly ash 9%,11%,13,dan 15% juga mengalami peningkatan nilai kuat tekan sebesar 41,897 MPa , 39,066 MPa , 40,764 MPa dan 33,404 MPa pada kadar fly ash 7% dan 15% pada umur 28 hari dibandingkan dengan beton normal (tanpa menggunakan fly ash) perbedaanya terlalu kecil ,maka didapat kadar optimal pada umur 28 hari adalah 9 % - 13 % dari berat semen. Kadar fly ash paiton berpengaruh pada kuat tekan beton umur 1 hari dan 28 hari.



**Kata Kunci:** ***beton 1 hari, fly ash, paiton, kuat tekan 28 hari.***



## Abstract

Based on the results of research and discussion that has been described, it can be concluded into which are as follows: Age care greatly affect the strength of concrete, At the age of 1 day compressive strength value obtained in content of *the fly ash* 7%, ie 17.410 MPa, the results obtained in content of *the fly ash* 7% stronger compared to the value of compressive strength of normal concrete (without the use of *fly* ash) is 15.287 MPa. In levels of fly ash 9% obtained an increase of 21.798 MPa and levels of fly ash 11% was obtained for 17.155 MPa, while the levels of fly ash 15% decline back in the amount of 15.853 MPa, thus the compressive strength by using fly ash Paiton optimal at the rate of 7% - 13%, due to higher compressive strength than normal concrete or without the use of fly ash, At the age of 28 days the compressive strength of concrete obtained at normal (without the use of *fly* ash), Experiencing an increase, compressive strength of normal concrete compressive strength is obtained to exceed the plan that is equal to 30.007 MPa. At the levels of fly ash 7% obtained higher scores than normal concrete in the amount of 32.272 MPa, whereas the levels of fly ash 9%, 11%, 13, and 15% also increased the compressive strength of 41.897 MPa 39.066 MPa

40.764 MPa 33.404 MPa at levels of fly ash 7% and 15% at 28 days compared with normal concrete (without the use of fly ash) the difference is too small, the importance of the optimal levels at 28 days was 9% - 13% of the weight of the cement, Paiton levels of fly ash concrete strength influence the age of 1 day and 28 days.

**Keywords:** ***early age concrete , fly ash, paiton, 28 days concrete.***

## 1. INTRODUCTION

Concrete is a primary requirement in a skyscraper, considering the effects of the use of glass which can lead to global warming and unsustainable then the modern era concrete is a solution to the construction of an environmentally friendly, there are several kinds of concrete over time many important thing we can find to a subject at a later date.

Many discoveries about the concrete starting from 1824, a scientist who discovered portland cement named Aspdin, then by JL Lambot in 1850 introduced the basic concepts of composite construction (combined two different construction materials that work together - together carry the load), In 1861 F. Coignet to test the use of iron distribution in roof construction, pipe anddome, in 1887 Gustav Wayss & Koenen and Hennebique introduce stirrups as anchoring the shear force and the use of beam "T" to reduce the burden of its own weight, and still a lot of research that utilize other concrete ,

Concrete characteristics have destroyed voltage high compressive and tensile crushed a low voltage, while the use of fly ash as filler is an empty cavity in order to increasingly close ties between the material and a binder such as portland cement.

Based on the above, this study aims to determine the compressive strength of high strength concrete were aged 1 day to add fly ash material Paiton, and how the influence of fly ash to concrete compared with normal concrete (0% fly ash).

## 2. METHOD

Concrete compressive strength is the magnitude of the load per unit area, which causes the crushed concrete test when burdened with a certain style, SNI 03-1974-1990 Based on testing concrete compressive strength can be calculated by the formula:

F’c = P/A..... ( III.3 )

with: F'c = Concrete compressive strength (MPa)

P = Maximum load (N)

A = Cross-sectional area (mm2)

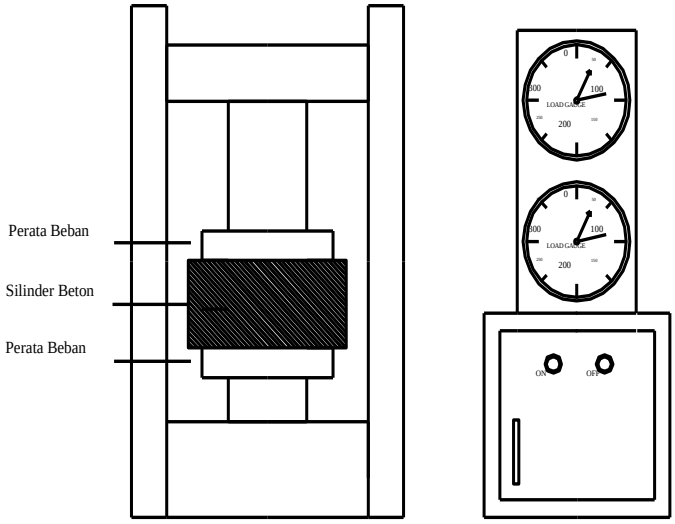


Figure 1. Model testing of compressive strength of concrete

### 2.1 Step By Step of Research

Stages of this study began from the preparation of the instruments and the provision of material, the examination of materials, planning and the manufacture of test objects as well as testing objects test as follows:

2.1.1 Step I: preparation tools and provision of material. This stage is the stage preparation stage of the study which includes preparation tools and provision of material composition concrete.

2.1.2 Step II : Material Correction.

At this stage done testing on old basic concrete which includes aggregate smooth and aggregate rough with examination covering the specific gravity of , heavy volume and analysis of a sieve.

2.1.3 Step III : Concrete Mixture.

Design and manufacture of a mixture of concrete mortar using design mix ( mix design that have been planned , and has been tested slump .Test objects in the form of concrete cylinder made total fruit the number is 18 .Care test objects by means of ignored in the room for a day.

2.1.4 Step IV : Pressure Test.

At this stage mechanical characteristic testing of concrete form of pressure test with testing procedures and calculation based on standard SNI and ASTM.

2.1.5 Step V : Conclution and Analysis.

At this stage data is collected from the testing and analyzed and discussed then took a conclusion.

## 3. ANALYSIS OF RESULTS AND DISCUSSION

Testing was conducted to determine the fine aggregate density *(specific gravit )* ,aggregate, organic content and the content of the mud. The results obtained during the study are presented in Table 1 Fine Aggregate Testing Results. Results of the calculations and test data completely contained in the annex.

**Table 1 Fine Aggregate Testing Results**

| Description | Standard ISO | Testing Results | Test Type |
|---|---|---|---|
| Meeting the requirements of | No. 1-5 | Colored No. 2 | Organic Matter Content of |
| Eligible | 5% Maximum | 3.8% | Gynecology Lumpur after being washed |
| Not listed in standard ISO | - | 1.08 | Weight of Dry Saturated *(Saturated Surface* Dry) |
| Not listed in standard ISO | - | of 2.33 | *(Apparent Specific* Gravity) |
| Not listed in standard ISO | - | 2.23 | Dry Bulk Specific Gravity |
| Qualify | Maximum of 5% | 2,04 | Water Absorption |
| Eligible | from 1.5 to 3.8 | 3.66 | Particle Finensess Modulus |

*(Source: test results)*

The test results of fine aggregate in accordance with the requirements of ASTM C33-97 can be seen in Table 2

**Table 2 Fine Aggregate Gradation Test Results**

| No | Sieve Size (mm) | Weight Sieve (gr) | Sieve + Sand (gr) | Weight sand (gr) | Correction | Weight Correction (gr) | Percentage Holding sand (%) | Percentage Cumulative (%) | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Hold | Pass |
| 1. | 9,5 | 410 | 410 | 0 | 0 | 0 | 0,00 | 0,00 | 100 |
| 2. | 4,75 | 420 | 420 | 0 | 0 | 0 | 0,00 | 0,00 | 100,00 |
| 3. | 2,36 | 430 | 460 | 30 | 0 | 30 | 6,74 | 6,74 | 93,26 |
| 4. | 1,18 | 355 | 445 | 90 | 0 | 90 | 20,22 | 26,97 | 73,03 |
| 5. | 0,6 | 335 | 465 | 130 | 0 | 130 | 29,21 | 56,18 | 43,82 |
| 6. | 0,3 | 320 | 425 | 105 | 0 | 105 | 23,60 | 79,78 | 20,22 |
| 7. | 0,15 | 390 | 460 | 75 | 0 | 75 | 16,85 | 96,63 | 3,37 |
| 8. | 0 | 380 | 395 | 15 | 0 | 15 | 3,37 | 100,00 | 0,00 |
| | | | ∑ = | 445 | | 445 | 100 | 366,29 | 433,71 |

Based on table 2 fine aggregate gradation test results can be described with the gradation graph as follows:

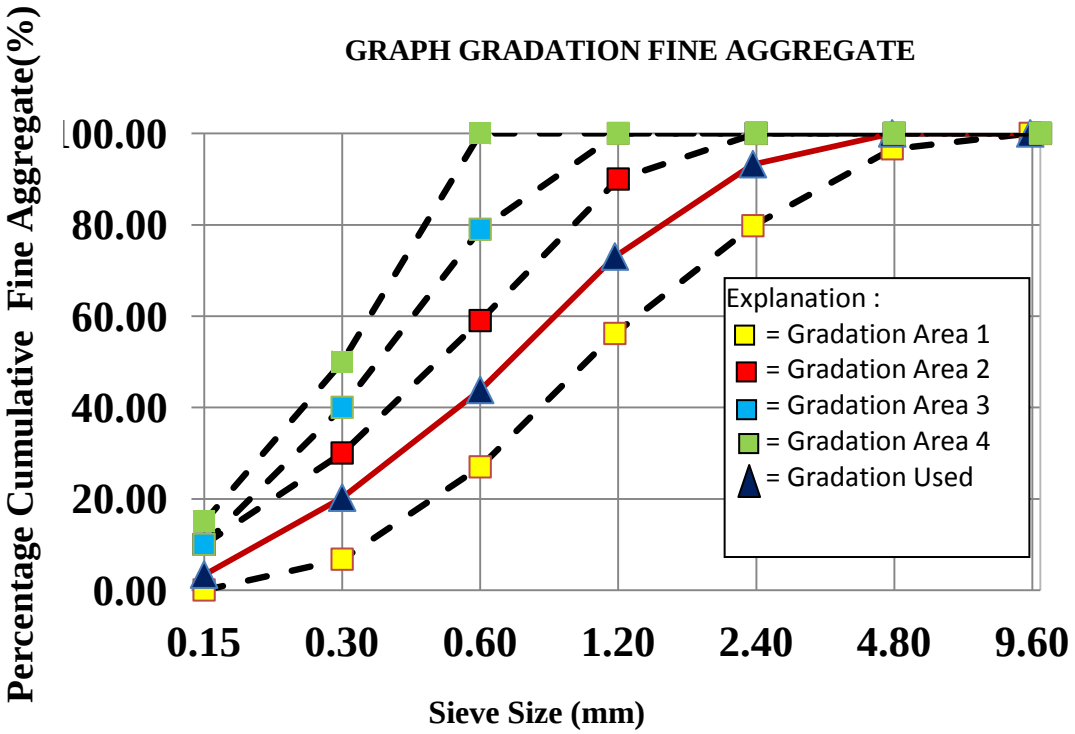


Figure 1 graph the relationship between the sieve size and the percentage of cumulative qualify Fine Aggregate

Based on the pictures V.1 graph the relationship between the sieve size and the percentage of the aggregate cumulative fine passes including gradation

region II. According to Tri Mulyono (2006), fine aggregate on the second gradation areas are included in the sand a bit rough.

**3.1 Coarse Aggregate testing Result**

Testing of coarse aggregate in this study was conducted to determine the wear on aggregate, density aggregates and aggregate. The test results can be seen in Table V.3 Testing Results Coarse Aggregates.

| Research Result | Testing Result | Standart SNI | Explanation |
|---|---|---|---|
| (Saturated Surface Dry) | 2,64 | - | - |
| (Apparent Spesific Gravity) | 2,8 | - | - |
| Weight Content of Bulk | 2,55 | - | - |
| Absorption | 3,58 | < 3% | Completed |
| Particle Fine Modulus | 8 | 5-8 | Completed |
| (*Source : Result* ) | | | |
| | | | |

Coarse aggregate test results taken from *Kulonprogro,* it can be concluded that the test results Saturated Dry weight (Saturated Surface Dry) obtained a value of 2.64. In apparent specific gravity testing on coarse aggregate generated 2.8, bulk specific gravity obtained the value of 2.55. From the test results on the water absorption of coarse aggregate used as a mixture in a concrete mix that is <3% while refined grains obtained modulus testing 8, it can be concluded that the coarse aggregate can be used as a mixture of concrete because it meets the requirements based on SNI.

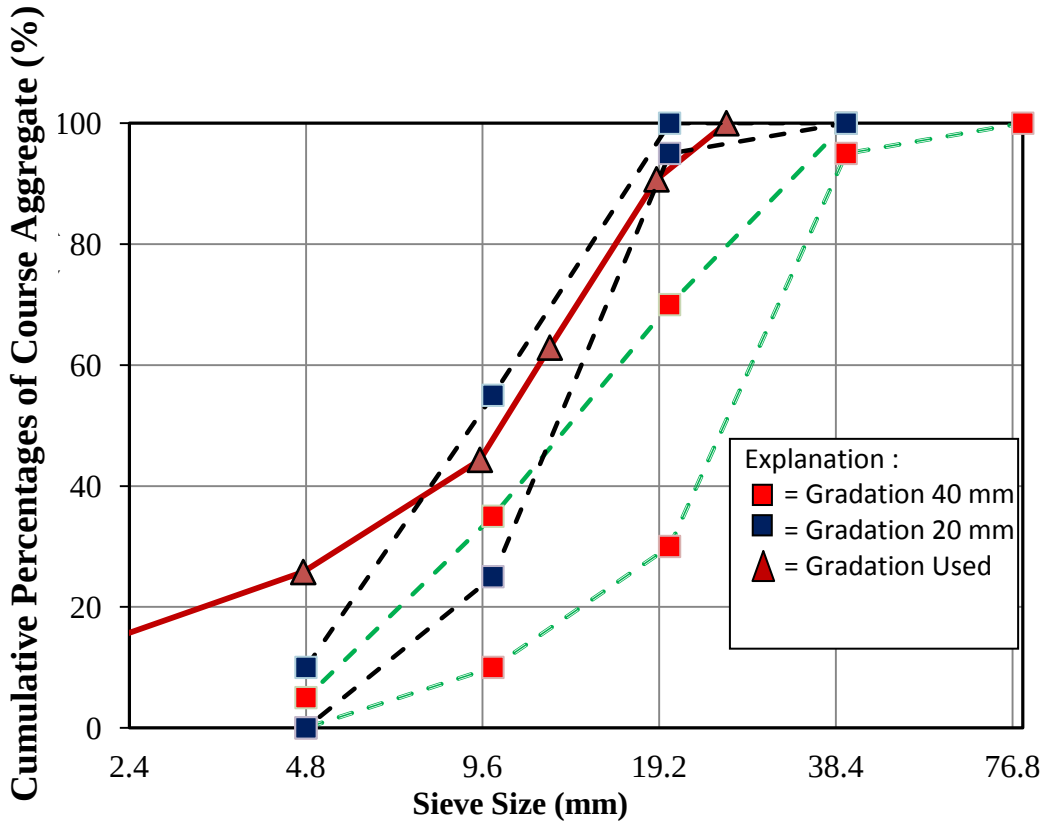


Figure 2 graph the relationship between the size of the sieves and Coarse aggregate cumulative percentage passes.

### 3.2 Testing Fly Ash

*(source: test results from Laboratory of Environmental Quality ITS, 2010)*

| Compiler % Massa | Substance | No. |
|---|---|---|
| 46.00 | $SiO_2$ | 1. |
| 6.79 | CaO | 2. |
| 11.63 | MgO | 3. |
| 10:11 | $Fe_2O_3$ | 4. |
| 2:15 | $Na_2O$ | 5. |
| 2.77 | $SO_3$ | 6. |
| 6:35 | $Al_2O_3$ | 7. |
| 0:12 | $H_2O$ | 8. |
| 0:40 | LOI | 9. |

from the test results *of fly* ash, it can be concluded that the *fly ash* Paiton is included *fly ash* class F due to the levels of lime (CaO) contained therein is less than 10% (ASTM C 61894a)

### 3.3 Proportion Mixed Normal Concrete

Table 4 concrete mixture proportions for each variation of *fly ash* per 1 Digesters

| *Fly Ash* (%) | Water (liters) | Fine Aggregate (g ) | Coarse Aggregate (g) | Portland Cement (g) | Fly Ash (g) | Objects Code Test |
|---|---|---|---|---|---|---|
| 0 | 1.192 | 2702 | 4054 | 3974 | 0 | K1 |
| | | | | | | K1 |
| | | | | | | K1 |
| 7 | 1.192 | 2702 | 4054 | 3696 | 278.18 | K2 |
| | | | | | | K2 |
| | | | | | | K2 |
| 9 | 1.192 | 2702 | 4054 | 3616 | 357.66 | K3 |
| | | | | | | K3 |
| | | | | | | K3 |
| 11 | 1.192 | 2702 | 4054 | 3537 | 437.14 | K4 |
| | | | | | | K4 |
| | | | | | | K4 |
| 13 | 1.192 | 2702 | 4054 | 3457 | 516.62 | K5 |
| | | | | | | K5 |
| | | | | | | K5 |
| 15 | 1.192 | 2702 | 4054 | 3378 | 596.10 | K6 |
| | | | | | | K6 |
| | | | | | | K6 |

Description:

K1 = Object Cylinder Test without Fly Ash
K2 = Object Cylinder Test with Fly Ash 7% level
K3 = Object Cylinder Test with levels of Fly Ash 9%
K4 = Object Cylinder test with Fly Ash content of 11%
K5 = Object Cylinder test with Fly Ash content of 13%
K6 = Object Cylinder test with Fly Ash 15% concentration.

### 3.4 Slump Test

Each content variation *fly ash* in concrete mixture slump testing. In this study is required to determine the value slump concrete performance level of each of the various levels of *fly ash* in the concrete mix..

| Value *Slump* | Name | No |
|---|---|---|
| 9 cm | K1 | 1 |
| 9 cm | K2 | 2 |
| 8 cm | K3 | 3 |
| 7 cm | K4 | 4 |
| 7 cm | K5 | 5 |
| 7 cm | K6 | 6 |

Table 5 *Slump* Test Results

From the table 6 can be described with a graph of the results slump value as follows:

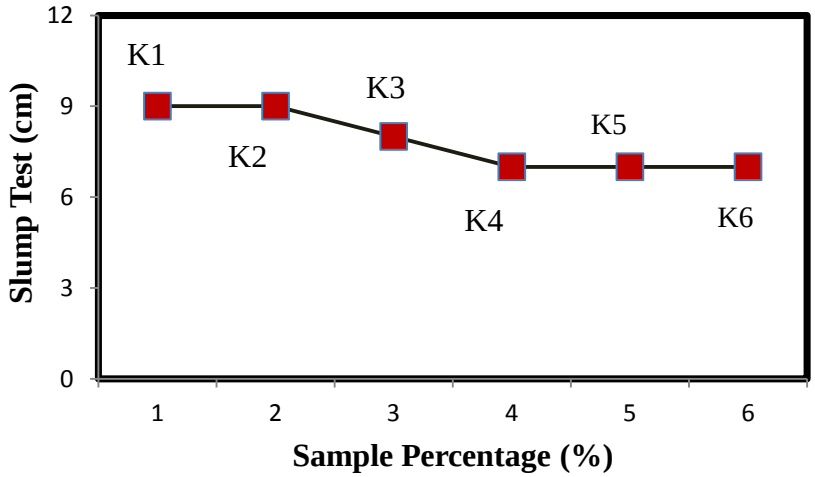


Figure 3 Graph value of *slump*

Description:
K1 = concrete withcontent of *fly ash* 0%
K2 = concrete withcontent of *fly ash* 7%
K3 = concrete withcontent of *fly ash* 9%
K4 = concrete withcontent of *fly ash* 11%
K5 = concrete with high levels of *fly ash* 13%
K6 = concrete with high levels of *fly ash* 15%

### 3.5 Testing Results and Analysis of Concrete Compressive Strength

Table 6 Compressive strength Calculation Analysis on Age 1 day

| Code Sample | Fly ash (%) | Weight (kg) | $P_{max}$ (kN) | $P_{max}$ (kg) | A ($cm^2$) | $f_c$, ($kg/cm^2$) | $f_c$, (MPa) | Average (MPa) |
|---|---|---|---|---|---|---|---|---|
| K1 – 1 | 0 | 11595 | 265 | 26500 | 176,625 | 150,035 | 15,004 | 15,287 |
| K1 – 2 | | 11215 | 275 | 27500 | 176,625 | 155,697 | 15,570 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| K2 – 1 | 7 | 11935 | 325 | 32500 | 176,625 | 184,006 | 18,401 | 17,410 |
| K2 – 2 | | 12450 | 290 | 29000 | 176,625 | 164,190 | 16,419 | |
| K3 – 1 | 9 | 12650 | 420 | 42000 | 176,625 | 237,792 | 23,779 | 21,798 |
| K3 – 2 | | 12370 | 350 | 35000 | 176,625 | 198,160 | 19,816 | |
| K4 – 1 | 11 | 12415 | 386 | 38600 | 176,625 | 218,542 | 21,854 | 17,155 |
| K4 – 2 | | 12840 | 220 | 22000 | 176,625 | 124,558 | 12,456 | |
| K5 – 1 | 13 | 12540 | 295 | 29500 | 176,625 | 167,021 | 16,702 | 17,749 |
| K5 – 2 | | 12535 | 332 | 33200 | 176,625 | 187,969 | 18,797 | |
| K6 – 1 | 15 | 12740 | 270 | 27000 | 176,625 | 152,866 | 15,287 | 15,853 |
| K6 – 2 | | 12480 | 290 | 29000 | 176,625 | 164,190 | 16,419 | |

The results of the testing and analysis of concrete compressive strength at 28 days results concrete compressive strength test on cylindrical test specimens aged 28 days treatment with a diameter of 15 cm and 30 cm high can be seen in table V.5 as follows:

Table 7 Compressive strength Calculation Analysis on age 28 days

| Sample Code | Fly Ash Content (%) | Weight (kg) | $P_{max}$ (kN) | $P_{max}$ (kg) | A ($cm^2$) | $f_c$, ($kg/cm^2$) | $f_c$, (MPa) | Average Compressive (MPa) |
|---|---|---|---|---|---|---|---|---|
| K1 – 1 | 0 | 11370 | 530 | 53000 | 176,625 | 300,071 | 30,007 | 30,007 |
| K2 – 1 | 7 | 12080 | 570 | 57000 | 176,625 | 322,718 | 32,272 | 32,272 |
| K3 – 1 | 9 | 12460 | 740 | 74000 | 176,625 | 418,967 | 41,897 | 41,897 |
| K4 – 1 | 11 | 12290 | 690 | 69000 | 176,625 | 390,658 | 39,066 | 39,066 |
| K5 – 1 | 13 | 12480 | 720 | 72000 | 176,625 | 407,643 | 40,764 | 40,764 |
| K6 – 1 | 15 | 12465 | 590 | 59000 | 176,625 | 334,041 | 33,404 | 33,404 |

Based on the average of the compressive strength and variation *fly* ash,it can be described as the following chart:

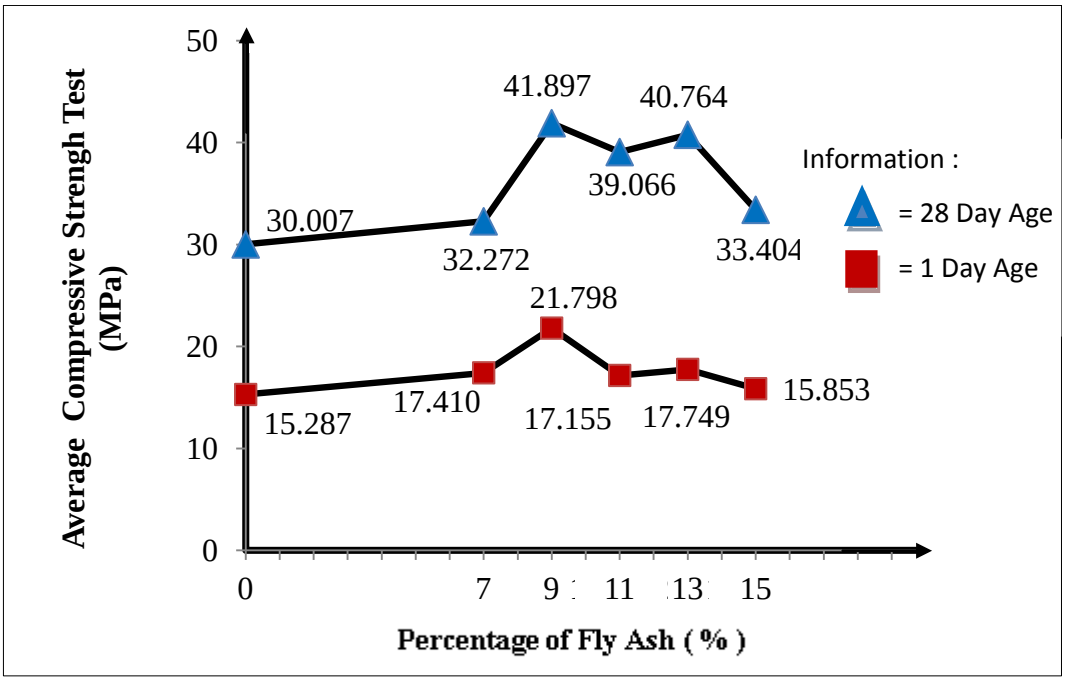


Figure 4 Graph Relationship of concrete compressive strength (MPa) and variations in the levels of *fly ash*.

By an average compressive strength and variations in the levels of fly ash can be concluded that optimal levels of fly ash is 7% - 11% , the more fly ash used for compressive strength will decrease, with the content of *fly ash* more than 11% of the results obtained compressive strength similar to normal concrete without the use of *fly* ash. Can be seen in the table above the compressive strength of normal concrete (0%) at the age of 1 day obtained at 15.287 MPa whereas at 28 days could reach 30.007 MPa, the use of *fly ash* 7% age 1 day gained 17.410 MPa whereas at 28 days was obtained 32.272 MPa, the use of *fly ash* 9% at 1 day gained 21.798 MPa whereas at 28 days was obtained 41.897 MPa, while the use of *fly ash* 11% at 1 day earned 17.155 MPa and at 28 days was obtained for 39.006 Mpa, on the use of *fly ash* 13% at 1 day and obtained 17.749 MPa at 28 days was obtained for 40.764 MPa, and the use of *fly ash* 15% at 1 day and obtained 15.853 MPa at 28 days was obtained for 33.404 MPa. So the difference in compressive strength is different for each variation of fly ash, with optimal use of fly ash in concrete that is 7% -11% by weight of

cement will add significant strength concrete and fly ash content exceeding 11% compressive strength will be reduced or equal to a strong of concrete at normal quality, due to the use of fly ash with high levels will require a slow time for drying.

# 4 CONCLUSION AND ADVICE

## 4.1 Conclusion

Based on the results of research and discussion that has been described, it can be concluded into which are as follows: 1) Age care greatly affect the strength of concrete. 2) At the age of 1 day compressive strength value obtained incontent of *the fly ash* 7%, ie 17.410 MPa, the results obtained incontent of *the fly ash* 7% stronger compared to the value of compressive strength of normal concrete (without *fly* ash) is 15.287 MPa.Pada levels of fly ash 9% obtained an increase of 21.798 MPa and levels of fly ash 11% was obtained for 17.155 MPa, while the levels of fly ash 15% decline back in the amount of 15.853 MPa, thus the compressive strength by using fly ash Paiton optimal at the rate of 7% - 13%, due to higher compressive strength than normal concrete or without the use of fly ash. 3) At the age of 28 days the compressive strength of concrete obtained at normal (without the use of *fly*ash), Experiencing an increase, compressive strength of normal concrete compressive strength is obtained to exceed the plan that is equal to 30.007 MPa. At the levels of fly ash 7% obtained higher scores than normal concrete in the amount of 32.272 MPa, whereas the levels of fly ash 9%, 11%, 13, and 15% also increased the compressive strength of 41.897 MPa 39.066 MPa 40.764 MPa 33.404 MPa at levels of fly ash 7% and 15% at 28 days compared with normal concrete (without the use of fly ash) the difference is too small, the importance of the optimal levels at 28 days was 9% - 13% of the weight of the cement. 4) Paiton levels of fly ash concrete strength influence the age of 1 day and 28 days.

### 4.2 Advice

4.2.1 For further research on the manufacture of concrete need to be tested using the type of PPC or Portland cement type III.

4.2.2 In a subsequent study to try *high-volume fly ash* with the use of Fly Ash Paiton, as flyash Paiton no effect on water or water cement ratio.

4.2.3 To research the *fly ash* must use a low water cement ratio.

4.2.4 Preferably before the compressive strength test in order to generate maximum compressive strength Cupping process is carried out beforehand.

4.2.5 Time mixing and pouring concrete on the mold should be less than 5 minutes.

4.2.6 Tested Testing compressive strength at the age of 56 days.

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SNI 03-1974-1990. "*Metode Pengujian Kuat Tekan Beton*". Badan Standarisasi (BSN).